COMPONENT 3 - REQUIREMENTS FOR LIFE

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement. Award the middle mark in the level if most of the content statements are given and the communication statement is partially met. Award the lower mark if only the content statements are matched.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*			animalia (1) **and** Any 3 of the following = 2 marks, Any 2 = 1 mark, 1 or 0 = 0 marks multicellular eukaryotes no cell wall nervous co-ordination heterotrophic	3			3		
	(b)	(i)		To become acclimatised/ adjusted to the surroundings (1)			1	1		1
		(ii)		Replace the air with normal air to restore normal breathing patterns (1)			1	1		1
		(iii)		Movement / contraction of body needed to force air in and out of tracheae (1)		1		1		
		(iv)		Air through spiracles (1) diffuses to tissue through the tracheal system (1)	2			2		
	(c)	(i)		Carbon dioxide (1) Increase of O_2 from 83-97% decrease of 7 breathing movements per minute (1) but increase of CO_2 from 0 – 3% increase of 35 (1)			3	3		1
		(ii)		Accept a number between 43 and 45 (1) Little difference between the results seen at 3 + 6%(1)			2	2	0	1
				Question 1 total	**5**	**1**	**7**	**13**	**0**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*			sensory , relay, motor neurones labelled correctly (1) synapses shown in grey matter (1) cell body of sensory neurone in dorsal root ganglion, other cell bodies in grey matter (1) sensory neurone in dorsal root and motor neurone in ventral root on opposite side (1)	1 1 1	 1		4		
	(b)			Chloride ions move in and potassium ions move out (1) Resting potential is lowered/ potential difference in post synaptic neurone becomes more negative (1) Threshold requires more depolarisation (1)		3		3		
	(c)			2.5 / 5.7 (1) 0.438….. (1) 0.44 (to 3 sig figures) (1)		3		3	3	
	(d)	(i)		Na^+ ion (voltage gated) channels open and Na^+ {flood / diffuse rapidly} into cytoplasm by facilitated diffusion (1) K^+ ion channels remain closed (1) More $^+$ions inside axon than outside (1) depolarisation of the axon membrane (1)	4			4		
		(ii)		Once the threshold potential is reached the same size action potential is generated (1) Correct ref to all or nothing (1)	2			2		
				Question 2 total	**9**	**7**	**0**	**16**	**3**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*	(i)		77 / 3 700 x 1000 (1) =20.8 μm (1)		2		2	2	2
		(ii)		exocytosis (1)	1			1		
	(b)			Stomach - thick layer to prevent damage by pepsin and hydrochloric acid(1) First part of duodenum - mucus layer thick prevent damage from acid from stomach(1) Ileum - mucus thin to allow more efficient absorption(1) Colon – thick mucus for lubrication as much water has been reabsorbed(1)		4		4		
	(c)			Conclusion is not valid although percentage is similar, the diet of the animals are different/ description of (1) Protein digested initially in stomach of wild dog (1) Cellulose digested by bacteria in {stomach / rumen} of sheep (1)			3	3		
				Question 3 total	**1**	**6**	**3**	**10**	**2**	**2**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*	(i)		Efferent arteriole narrower than afferent/ ORA/ ventricular systole (1)	1			1		
		(ii)		Protein(1)	1			1		
		(iii)		Down water potential gradient by osmosis(1)	1			1		
		(iv)		10 – 6.7(1) 3.3kPa(1)		1		1		
	(b)	(i)		Active transport + Facilitated diffusion (1) both use carrier proteins in the membrane(1) Graph levels off when all carrier proteins are occupied(1)	3			3		
		(ii)		Glucose taken up by active transport(1) Active transport requires ATP (1) Cyanide prevents oxidative phosphorylation so no ATP produced (1)		3		3		
	(c)			The longer the loop of Henle the better adapted the organism is to a dry environment/ORA(1) Because the urine is more concentrated as the longer the loop of Henle more water is reabsorbed/ ORA (1) Therefore less water is lost by organisms living in xeric conditions(1) beaver does not need to control water loss as lives in aquatic habitat therefore loop of Henle is short(1)			4	4		
				Question 4 total	**6**	**4**	**4**	**14**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			50 x 3.14 x 0.5^2 (1) = 39.25/10 = 3.925 ($mm^3\ min^{-1}$)(1) 3.9 (1)		3		3	3	
	(b)	(i)		**4** for **2** marks/ OR any **2/3** for **1** mark from: Temperature Humidity Wind speed Light intensity			2	2		2
		(ii)		Measure surface area of leaves(1) Calculate result as water loss per mm^2 of leaf / express result in $mm^3\ min^{-1}mm^{-2}$ (1)			2	2		2
	(c)			water produced in respiration and used up in photosynthesis (1) Some water produced in respiration when oxygen accepts final electron and combines with protons (1) Some water used in photosynthesis during photolysis to provide protons for ATP synthesis(1)	1	2		3		
				Question 5 total	**1**	**5**	**4**	**10**	**3**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*			4 (1)		1		1		
	(b)			Transcription of genes for alpha and gamma chains (1) Produces mRNA (1) Translation by ribosomes to produce alpha and gamma polypeptides(1) Combination of alpha and gamma chains to give quaternary structure(1)		4		4		
	(c)			Advantages: Increased oxygen affinity (1) More oxygen absorbed (1) Disadvantage: Less oxygen released at low partial pressures of oxygen (1)		3		3		
				Question 6 total	**0**	**8**	**0**	**8**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7				Indicative content ADH is a hormone which controls water loss from the body by affecting the permeability of the collecting duct walls in the kidney. As more water is reabsorbed the water potential of the urine falls and the water potential of the blood will rise. The volume of blood in the body will rise because of the increased water levels. Ecstasy increases the concentration of ADH in the blood and therefore more water is reabsorbed into the blood . The normal homeostatic control of water levels in the body is affected. The body is unable to get rid of excess water in the urine and this results in the water potential of the blood rising. Cells will absorb water by osmosis and expand possibly bursting and the pressure of the brain against the cranium increases. Blood pressure increases because there is more water in the blood which increases the volume and causes a dilution of ions such as sodium in the blood. The cells in the body cannot tolerate changes in the cellular environment and fluctuations from the norm will result in the impairment of the normal physiology within cells. **7-9 marks** The candidate gives a full and detailed explanation of the role and function of ADH in the control of water concentration in the body, including reference to water potential. The effect of ecstasy with relation to ADH is also clearly explained. A clear account of the effects on the body is given including effect on cells, blood pressure, dilution of ions and the effect on physiology.	2	5	2	9		

				The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately. **4-6 marks** The candidate gives an explanation of the role and function of ADH in the control of water concentration in the body, including some reference to water potential. The effect of ecstasy with relation to ADH is explained. A clear account of some of the effects on the body is given including two of cells lysis, blood pressure, dilution of ions and the effect on normal physiology. *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** The candidate gives a brief explanation of the role and function of ADH in the control of water concentration in the body. The link between ecstasy and water concentration is mentioned. Some attempt at the effects on the body is given. *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.* **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.						
				Question 7 total	**2**	**5**	**2**	**9**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
Option A										
8	*(a)*			Bacteria can be treated with antibiotics + viruses not affected (1) Accept: <u>only</u> bacteria affected by antibiotics	1			1		
	(b)	(i)		Antibiotics have killed bacteria in region around discs (1) No clear zone observed (1)	2			2		
		(ii)		Use different concentrations of <u>same</u> antibiotic (1) measure {diameter / area} of bacteria killed (1)			2	2		2
	(c)	(i)		Prevent the division of bacteria (1) 1.5 μg cm^{-3} (1)		2		2		
		(ii)		Gives quantitative data/ Actual concentration at different points known (1)			1	1		1
		(iii)		Antibiotic 1 (1) Causes inhibition /death of bacteria at <u>lowest</u> concentration (1)			2	2		
	(d)	(i)		Affect metabolic processes common to most bacteria (1)	1			1		
		(ii)		A microorganism which should be affected by an antibiotic is no longer susceptible to it OWTTE (1)	1			1		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(e)*			Tetracycline affects protein synthesis which is common to all bacteria (1) (AO2) Gram -ve bacteria have an {outer / protective} layer of {lipopolysaccharide / lipoprotein} (1) (AO1) Prevents penicillin reaching murein cell wall (1) (AO2)	1	2		3		
	(f)	(i)		at 22 days: concentration = $10^{1.26}$ = 18.20 µg cm^{-3} (1) at 40 days: concentration = $10^{2.85}$ = 707.95 µg cm^{-3} (1) increase = 707.95 – 18.2 = 689.75 µg cm^{-3} (1)		3		3	2	
		(ii)		Booster stimulates higher number of memory cells (1) Antibodies produced faster if exposed to the infection (1)		2		2		
				Option A Question total	**6**	**9**	**5**	**20**	**2**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
Option B										
9	*(a)*	(i)		80 eye piece units = 98 stage micrometer units (1) 1 epu = $\frac{98 \times 10}{80}$ (1) = 12.25μm (1)		3		3	2	2
		(ii)		Eye piece unit has different values for each calibration (1)		1		1		1
		(iii)		Haversian canal in LS at centre, lacunae in parallel strips (1)		1		1		
	(b)	(i)		Protein synthesis (1) For release / secretion from cell (1)		2		2		
		(ii)		Arteries and veins in Haversian canals (1) Haversian canals connected by Volkmanns canals (1) Capillaries in canaliculi (1)	3			3		
	(c)			Lack of Vitamin D and calcium from milk (1) not enough time exposed to sun for vitamin D production(1) Vitamin D needed for absorption of calcium from gut (1)			3	3		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	*(d)*	(i)		Any **3** (x1) from: Released from sarcoplasmic reticulum binds to troponin (1) Troponin changes shape (1) Moves tropomyosin away from binding sites on actin (1) Cross bridges can then form (1)	3			3		
		(ii)		Energy from ATP needed to break cross bridge (1) No respiration in muscle after death therefore ATP not synthesised (1)		2		2		
	(e)			Person B extreme endurance athlete + high numbers mitochondria / large amount myoglobin + aerobic, +fatigue slowly (1) Person C world class sprinter + anaerobic + quick contraction + strong force (1)			2	2		
				Option B Question total	**6**	**9**	**5**	**20**	**2**	**3**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td colspan="4">Option C</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>10</td><td>(a)</td><td>(i)</td><td></td><td>Produces an image/diagnosis faster (1)</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>May cause a stroke resulting in paralysis (1)
In the left side of the body (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td colspan="11"></td></tr>
<tr><td></td><td>(b)</td><td colspan="3"></td><td>
<table>
<tr><th>Activity</th><th>Letter</th><th>Part</th></tr>
<tr><td>Regulating
core body temperature.</td><td>B</td><td>Thalamus (1)</td></tr>
<tr><td>Recognising a face in a picture.</td><td>A</td><td>Cerebral
hemisphere (1)</td></tr>
<tr><td>Drinking from a glass.</td><td>D</td><td>Cerebellum (1)</td></tr>
<tr><td>Regulating the CO_2
concentration of the blood.</td><td>C</td><td>Medulla
oblongata (1)</td></tr>
</table>
</td><td></td><td>4</td><td></td><td>4</td><td></td><td></td></tr>
<tr><td colspan="11"></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td></td><td>Increased (rate of) respiration - more carbon dioxide(1)
Chemoreceptors in the carotid/aortic sinus detect a decrease in blood pH (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>More nerve impulses are sent to the SAN (1)
Along the sympathetic neurone resulting in the release of more noradrenalin (1)
SAN discharges at a higher frequency (1)</td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td colspan="11"></td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td></td><td>t= 12.57(2)
1 mark for correct substitutions
$t = \frac{|15.8 - 16.5|}{\sqrt{\left(\frac{2.05^2}{20} + \frac{2.61^2}{20}\right)}}$</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	*(d)*	(ii)		t value is greater than the critical value at 0.001/ there is a chance of below 0.001 that the differences in the mean turning rate are due to chance + Reject null hypothesis (1)			1	1		
		(iii)		Kinesis + movement of the woodlice away from the stimulus(1)		1		1		
		(iv)		In dry conditions the woodlice turns more frequently to try to leave the area of dry conditions and find moist conditions (1) Because in dry conditions the gills of the woodlice would dry out (1)			2	2		1
		(v)		Use dry filter paper in the bottom of the petri dish in dry conditions/ use a range of humidity (1) Longer time period (1)			2	2		2
				Option C Question total	**6**	**9**	**5**	**20**	**2**	**3**

COMPONENT 3: REQUIREMENTS FOR LIFE

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Q	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	**5**	**1**	**7**	**13**	**0**	**4**
2	**9**	**7**	**0**	**16**	**3**	**0**
3	**1**	**6**	**3**	**10**	**2**	**2**
4	**6**	**4**	**4**	**14**	**0**	**0**
5	**1**	**5**	**4**	**10**	**3**	**4**
6	**0**	**8**	**0**	**8**	**0**	**0**
7	**2**	**5**	**2**	**9**	**0**	**0**
SECTION A TOTAL	**24**	**36**	**20**	**80**	**8**	**10**
SECTION B TOTAL	**6**	**9**	**5**	**20**	**2**	**3**
OVERALL TOTAL	**30**	**45**	**25**	**100**	**10**	**13**